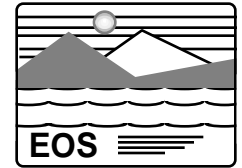# EOS AM-1 SCIENCE OVERVIEW

DR. YORAM KAUFMAN
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Greenbelt, MD 20771 USA
E-mail: yoram.kaufman@gsfc.nasa.gov

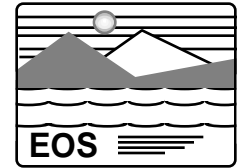# EOS AM Science Team

Yoram Kaufman – AM Project Scientist (new)

Jon Ranson – Deputy AM Project Scientist

Jim Collatz – Associate in Relation to IDS Investigations

Francesco Bordi – AM Project Liaison

EOS AM-1 Instruments

ASTER – Advanced Spaceborne Thermal Emission and Reflection Radiometer

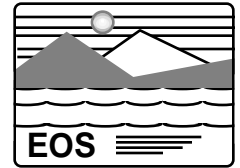**CERES – Clouds and the Earth's Radiant Energy System**

MISR – Multiangle Imaging Spectroradiometer

MODIS – Moderate-Resolution Imaging Spectroradiometer

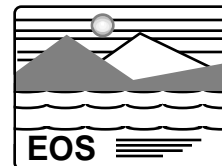**MOPITT – Measurements of Pollution in the Troposphere**

"Is the mean temperature of the ground in any way influenced by the presence of the heat-absorbing gases in the atmosphere?"

– S. Arrhenius*, Philosophy Magazine and Journal of Science, 1896

———————

***The first to calculate the effects of doubling by CO_2**

Scientific Priorities
of MTPE and EOS

- *<u>Land cover change and global productivity</u>* **– Trends and patterns of change in regional land cover, biodiversity and global primary production**

- *<u>Seasonal to Interannual climate prediction</u>* **– Improve forecasts of timing and geographical extent of transient climate anomalies such as El Niño and volcanoes**

- *<u>Natural hazards</u>* **– Disaster characterization and risk reduction from earthquakes, wildfires, volcanoes, floods, and droughts**

- *<u>Long-term climate variability</u>* **– Determine mechanism and factors that determine long-term climate variation and trends, including human impact**

- *<u>Atmospheric ozone</u>* **– Detect changes, causes, and consequences of changes in atmospheric ozone**

Specific Objectives of EOS AM-1
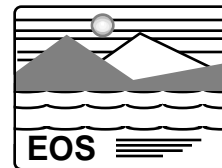
1. **Provide the first state distribution of the main Earth-atmosphere coupled measurements (1 to 2 years)**

   V – global bio-productivity (land and oceans)

   L – land use, land cover, snow and ice

   T – global surface temperature – day and night

   C – clouds (macrophysics, microphysics, and radiative effects)

   R – radiative energy fluxes

   A – aerosol properties and water vapor

   F – fire occurrence and trace gases

2. **Improve the knowledge of detection of human impact on climate: "fingerprints" (1 to 2 years)**

   – Compare climate models with updated global distributions of land use change, aerosol, water vapor, clouds and radiation, trace gases, and oceanic productivity with measurements

Specific Objectives of EOS AM-1 (Cont'd)
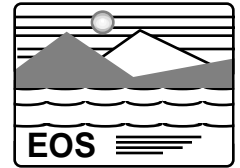
3. **Improve forecasts of the timing and geographical extent of transient climatic anomalies (1 to 2 years)**

   – **Investigate relation of regional and annual variations of clouds, aerosol, water vapor, biota in land and oceans, fires and trace gases, the radiation field to major impacts: El Niño, volcanic activity**

4. **Improve seasonal and interannual predictions using EOS-Arrhenius (and later EOS-altimeter/radar, PM-1) data set (1 to 6 years)**

5. **Develop technologies for disaster prediction and characterization and risk reduction from wildfires, volcanoes, floods, and droughts (1 to 2 years)**

6. **Start EOS monitoring of change in climate and global environment (1 to 15 years)**

Contribution of EOS Arrhenius to MTPE
## 24 Prioritized Global Environmental Variables

EOS
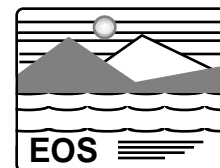
Discipline	Measure	EOS AM-1 Instrument	Fulfillment of the Measure
ATMOSPHERE	**Cloud Properties**	MODIS, CERES, MISR ASTER/Landsat	Full
	Radiative Energy Fluxes	CERES	Full
	Precipitation	—	—
	Tropospheric Chemistry	MOPITT	Partial
	Stratospheric Chemistry	MOPITT	Partial
	Aerosol Properties	MISR, MODIS	Full
	Atmospheric Temperature	MODIS	Partial
	Atmospheric Humidity	MODIS	Partial
	Lightning	—	—
LAND	**Land Cover and Land Use Chan**	MODIS, MISR, ASTER/Landsat	Full
	Vegetation Dynamics	MODIS, MISR, ASTER/Landsat	Full
	Surface Temperature	MODIS, ASTER	Full
	Fire Occurrence	MODIS, ASTER	Full
	Volcanic Effects	MODIS, ASTER	Full
	Surface Wetness	MODIS	Partial
OCEAN	**Surface Temperature**	MODIS, ASTER	Full
	Phytoplankton & Dissolved Organic Matter	MODIS, MISR	Full
	Surface Wind Fields	—	—
	Ocean Surface Topography	—	—
CRYOSPHERE	*Ice Sheet Topography & Ice Vol Change*	—	—
	Sea Ice	MODIS, MISR, ASTER/Landsat	Full
	Snow Cover	MODIS, MISR, ASTER/Landsat	
SOLAR RADIATION	**Total Solar Irradiance**	—	—
	Ultraviolet Spectral Irradiance	—	—

Note: Italicized measures are not performed by AM-1.
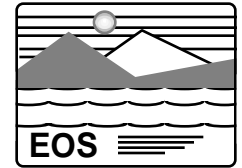
Early Scientific Results for EOS AM
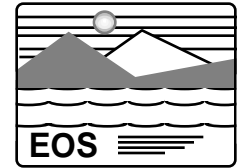
- **Images/videos (2 months) from several instruments**
  - **Examples**
    - » **Hurricane**
    - » **Volcano (preferably with fire)**
    - » **Wildfire**
    - » **Deforestation scars and fires**
    - » **Glacier**
- **Product images and video (6 to 12 months)**
  - **Examples**
    - » **Global annual cirrus cloud cover, properties**
    - » **Seasonal variation of fires in the tropics**
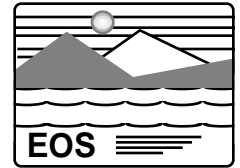   - » **Seasonal variation of bio-productivity**

- **Major science impact (1 to 2 years)**
  - **Examples**
    - » **Droughts, changes in land and ocean biota**
    - » **Fingerprints of climate change**
    - » **Seasonal predictions (El Niño)**
    - » **Annual deforestation/reforestation**
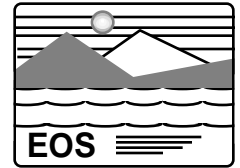- **Early Science Advisory Board**

Science Management

- **Land algorithm theoretical basis document (ATBD) Workshop**
    - **Excellent critical review document**

- **International workshop on remote sensing of aerosol and atmospheric corrections**
    - **EOS, Advanced Earth Observing Satellite (ADEOS), Environmental Satellite (ENVISAT), intercomparisons, JGR special issue, discussion summaries**

- **Plans for cloud international workshop**

- **LAND workshops**

- **MODIS Modelers (MODLERS) meeting**

- **International Land Surface Temperature**

- **International Fire Algorithm Workshop [International Geosphere-Biosphere Programme (IGBP)]**

Science Management (Cont'd)

- **Land Cover Workshop**

- **International Bidirectional Reflectance Distribution Function (BRDF) Meeting**

- **Instrument Liaison Systeme pour l'Observation de la Terre (France) (SPOT) [Vegn/Polder, Global Imager (GLI)]**

- **EOS Test Site Coordination Meeting**

- **ATBD second review in November and December**

- **Version 1 delivery, EOS science driven software**

- **Schedule for Version 2 depends on EOS Data and Information System (EOSDIS) schedule, final version software**

- **New science team members and new interdisciplinary science (IDS) investigators selected**

Interaction With EOSDIS
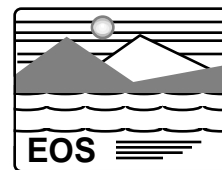
- **Project Scientist and Science Working Group for the AM Project (SWAMP) provide guidance for implementation by IOTs and EOSDIS**

- **Project Scientist resolves conflicts as needed during the mission**

- **Discussion of options in the context of the EOSDIS replan**

- **Science software needs time for proper integration and testing. No last-minute changes in environment. Deep science involvement is necessary.**

- **Contingency plans and activities need to be initiated by instrument teams (ITs) and Distributed Active Archive Centers (DAACs) with ESDIS to allow production and distribution of data at launch**

- **Phase-in implementation of the science; start with reduced data rate (resolution)**

Prelaunch Validation
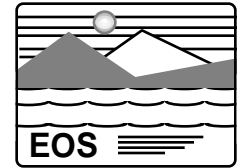
- **Smoke Cloud and Radiation MODIS atmosphere and land experiment in Brazil**

- **Advanced Very High Resolution Radiometer (AVHRR) global fire prototyping – IGBP**

- **Chile Version 1 algorithm testing – land**

- **Validation Prototyping Campaign (United States, 1997)**

- **Preparation for postlaunch validation**

  - **AErosol RObotic NETwork (Aeronet), West Virginia**

  - **Announcement of Opportunity (AO) approximately December**

- **Regional Science Assessment and EOS Validation Campaign (southern Africa, 1999)**

Conclusions
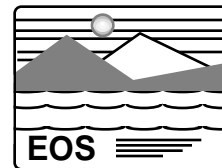
- **Focus science on the AM-1 mission as part of EOS 15-year record and as an independent first EOS platform**

- **Advantages to science of integrated five-instrument platform**

- **Brochure for EOS AM-1: Summary of Mission and Science**